



Biomolecular Systems Research Program

Microbial Assay technologies for Space (MATs): A Coordinated Ecosystem Response Assay Technology

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Among NASA's primary goals are the imperatives to further our knowledge of how life from Earth can adapt to space conditions. To date, much of NASA's biological research has focused on higher plants and animals. However, life on Earth is dominated by microbes, in terms of biomass, overall rates of activity, use of potentially available habitats, and length of time present on the planet. Microbes are intimately associated with humans and are necessary for regenerative cycling of energy and elements in enclosed systems (space) just as they are on the Earth.

Innovative Claims/NASA Significance

The key concept of the proposed research is that cells interact and respond with one another and their environment. The signal transduction between cells allows coordination of activities such as the building of complex biofilm, microbial mat and stromatolite structures. The physical structures that the microbes build in turn modify their environment creating micro-environments where specialized reactions can occur. An important point to keep in mind is that these microbes are mostly mobile, and hence can adjust their location in a given environment to optimize for their metabolic success. The proposed research seeks to develop an integrated approach in order to quickly detect changes in microbial community populations or activities as a response to both internal cycles and external perturbations. Such technology would have a wide range of biomedical applications.

Description

We propose to develop a core capability to produce and manipulate small scale microbial communities as defined "test systems," and to implement microscale technologies for tracking population, process and product changes in these test systems as a function of experimental manipulations.

This project would provide for the development of an incubation chamber prototype, capable of remote deployment, which will allow for the maintenance and analyses of mixed population photosynthetic biofilms and microbial mats. This chamber will be designed and built to allow for the use of various imaging, sampling, microsensor and molecular techniques to assess the mat population responses to various stimuli.

Plans

- 1) a portable incubation chamber for ground based use,
- 2) a core capability to produce and manipulate small scale microbial communities within that chamber,
- 3) techniques to combine small scale sampling and molecular technologies for tracking population changes,
- 4) Image archiving system for visual tracking of biofilm structural changes,
- 5) optimized microsensor methods for detecting product changes in these test systems as a function of experimental manipulations,
- 6) microscale sampling techniques for the detection of cell to cell communication (quorum sensing) by high performance liquid chromatography-HPLC and
- 7) a prototype design for a space deployable mat incubation chamber.